MONITORING OF DROUGHT ON THE CHMI WEBSITE

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ABSTRACT

Czech Hydrometeorological Institute (hereinafter referred to as 'CHMI') provides monitoring of agricultural drought on its website (www.chmi.cz). This is a regular and operational service that CHMI provides in the vegetation period (April to September). The main output of drought monitoring on the website is a map that shows the risk of threat of agricultural drought for the territory of the Czech Republic. It defines five levels of threat of drought, namely: 1 - slight, 2 - moderate, 3 - medium, 4 - high, 5 - peak. The higher is the level, the greater is the threat of agricultural drought.

Key words: drought, CHMI, monitoring, agricultural drought, threat of drought

INTRODUCTION

The aim of our work is to briefly introduce the CHMI website dedicated to the issue of (mainly) agricultural drought monitoring. Drought is one of the least explored natural threats that adversely affect a large part of the human population. Meteorologický slovník výkladový a terminologický (1993) describes drought as a very vague but in meteorology frequently used term, meaning basically the lack of water in the soil, plants or the atmosphere. According to Beran M. and Rodier J. A. (1985), the main property of drought is the decreased availability of water at certain times and areas. Drought in Central Europe is formed randomly compared to permanent, possibly seasonal drought in other climate zones (Červený J. *et al.* 1984). There are no uniform criteria for quantitative definition of drought, especially with regard to various meteorological, hydrological, agricultural, paedological, bioclimatological aspects and a variety of other conditions, even with respect to the damage in various areas of the national economy (Sobíšek B. *et al.* 1993). Meteorologický slovník výkladový a terminologický (1993) characterizes the following types of drought: **meteorological drought (**can be most frequently defined by time and space precipitation conditions, such as the prevalence of a dry or arid period), **agricultural (agronomic) drought** (can be defined as a lack of water in the soil influenced by previous or even still persistent occurrence of meteorological drought), **hydrological drought** (can be defined for surface watercourses by a certain number of consecutive days, weeks, months and even years with the occurrence of relatively very low flows with regard to monthly or annual standards), **physiological drought** (can be defined as a lack of water in terms of the needs of individual plant species). Another part of the presented material describes selected procedures for the analysis of possible drought in the Czech Republic that are applied in the operational service of CHMI.

MATERIAL AND METHODS

CHMI provides agricultural drought monitoring (drought monitoring) on its website (www.chmi.cz). This is a regular and operational service using which CHMI, specifically the Department of Biometeorological Applications in Prague and the Department of Meteorology and Climatology in Brno, provides in the vegetation period (April to September) a number of agro-meteorological information in relation to the possible manifestations of climatological, agricultural and paedological drought.

A. Risk of agricultural drought threat

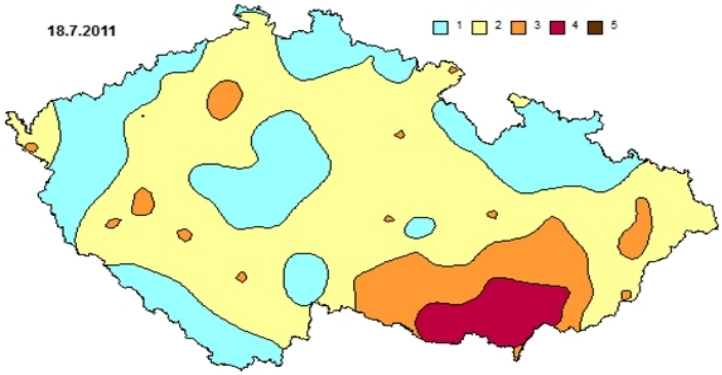

Fig. 1 Risk of agricultural drought threat in the Czech Republic on July 17, 2011

The main output of drought monitoring on the website is a synoptic map that shows the risk of threat of agricultural drought for the territory of the Czech Republic. It defines five levels of threat of drought, namely: 1 - slight, 2 - moderate, 3 - medium, 4 - high, 5 - peak. The higher is the level, the greater is the threat of agricultural drought. The resulting map is created by a compilation of results obtained from three methods of agricultural drought evaluation (method 1: measurement of soil moisture by VIRRIB sensors at certain depths 0-10 cm, 10-40 cm, 40-90 cm; method 2: calculated soil moisture balance under grassland using the BASET model; method 3: calculated basic or potential moisture balance of precipitation and potential evapotranspiration of grassland using the AVISO model. The update of the resulting map is performed once a week on Monday or Tuesday while the results obtained are always related to the previous Sunday.

The system of operating monitoring of humidity-climatic conditions in the Czech Republic was created approximately six years ago. The calculations of selected agro-climatic characteristics are performed in daily intervals according to the basic meteorological parameters (air temperature and humidity, sunshine, wind speed and precipitation) measured at climatological stations, e.g. the AVISO model is based on 184 stations in 2013, soil moisture is measured at 40 stations. The above illustrative example of data processing relates to Sunday, July 17, 2011.

B. Detail information

In addition to the resulting map of the risk of agricultural drought threat (see Fig. 1), the website also states other information on the issue of a possible drought occurrence.

B1. Soil moisture measured under grassland in the soil layer of 0-10 cm, 11-50 cm and 51-90 cm

Soil moisture is measured by special VIRRIB sensors in three soil layers at more than 30 climatological stations of CHMI. The maps show soil moisture as a percentage of available water capacity (AWC) which measures the proportion of water available in the soil. For better clarity, the maps show the following categories of soil moisture: 1 - very high soil moisture (> 90% AWC), 2 - high soil moisture (70-90% AWC), 3 - good soil moisture in agricultural terms (50-70% AWC), 4 - weak soil moisture (30-50% AWC), 5 - low soil moisture (10-30% AWC), 6 - very low soil moisture (0-10% AWC).

B2. Moisture balance of soils covered with grassland

To calculate the moisture balance of soils the **BASET** model is used („**B**ilance **A**tmosférických **S**rážek a **E**vapo**T**ranspirace“ - Balance of Atmospheric Precipitation and Evapotranspiration), developed in the Department of Biometeorological Applications in Prague. The model sums up the upper part of the soil horizon to a depth of approximately 20 cm. Moisture is expressed as a percentage of available water capacity. This hydrolimit characterizes the maximum amount of water in a given volume of soil which the plant is able to use. The resulting values are model values and largely depend on both the weather in a given place, especially on the precipitation process and air temperature, and on the paedological characteristics of climatological stations.

B3. Basic balance of precipitation and potential evapotranspiration of soils covered with grassland

The moisture conditions in the region are often expressed by a moisture balance. The basic moisture balance represents, in a simplified view, a simple difference between precipitation (receipt component of the water cycle in the region) and total (potential) evaporation (dispensing component of the water cycle in the region), without taking into account the rise of water from deeper soil layers. The total evaporation is represented here by potential, i.e. maximum possible evapotranspiration of grassland which is calculated in the daily intervals by a modified procedure according to the Penman-Monteith algorithm (the same algorithm is applied in the BASET model). The calculation is performed by the **AVISO** model („**A**grometeorologická **V**ýpočetní a **I**nformační

SOustava“ - Agrometeorological Calculation and Information System) developed in recent years in the Department of Agrometeorology and Phenology in Brno and now operated by the Department of Meteorology and Climatology in Brno for the model soils (light, heavy, medium-heavy soils) characterized by typical available water capacity. The output is model, not measured agro-climatic characteristics (essential moisture balance, evapotranspiration) that are within the drought monitoring transparently and regularly presented for the entire territory of the Czech Republic at weekly intervals. Apart from the above mentioned characteristics, the other outputs used in the model include for example current deficit of the soil with grassland, respectively with selected crops and the reserve of usable water in the soil under grassland balanced up to a depth of active rooting of the soil horizon.

RESULT AND DISCUSSION

The weather progress in the Czech Republic in summer 2013, on June 30 and August 18, is documented graphically depicted by basic moisture balance of grassland (Fig. 2 and Fig. 3). Basic (potential) moisture balance of grassland in mm is determined by the difference of the measured precipitation amount and model-calculated potential evapotranspiration of grassland. Generally, the lower the water balance, the higher likelihood of occurrence of possible drought (in this case, meteorological drought). The period of several weeks before June 30 was characterized in the majority of the territory of the Czech Republic characterized by intense precipitation activity when the precipitation significantly exceeded the long-term average for the period of 1961-2010 (weekly precipitation amount in many places were 150 % or more long-term precipitation). From July to August 18, the territory of the Czech Republic was characterized by very high air temperatures (maximum value at more climatological stations exceeded 35 °C in the afternoon) accompanied by the national precipitation-less weather. In this period, many places of the country were significantly influenced by drought. Some areas of southern and central Moravia and also the region of Pardubice (see Fig. 3) show the moisture balance below -100 mm (exceptionally -150 mm) which can be considered exceptional drought.

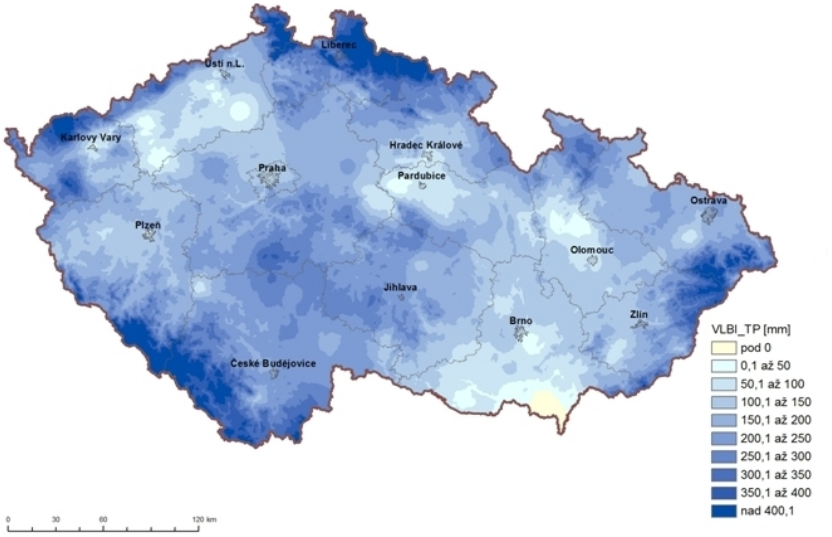

Fig. 2 Basic (potential) moisture balance of grassland (mm) in the Czech Republic on June 30, 2013

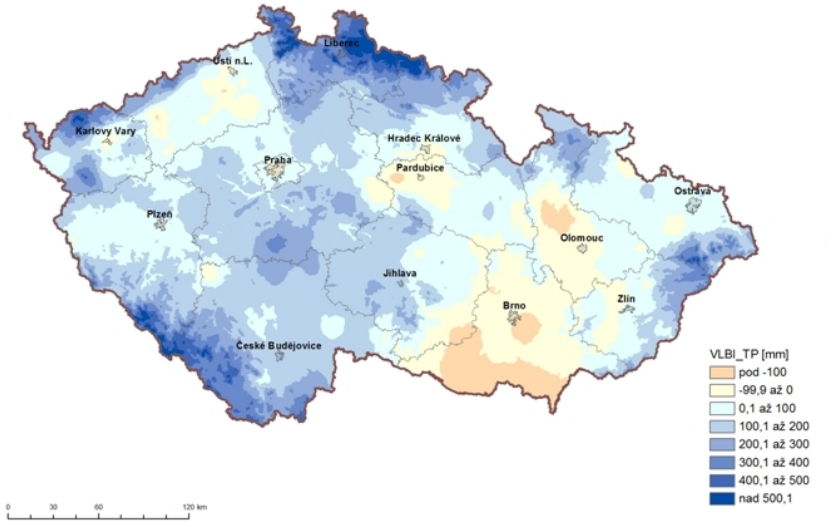

Fig. 3 Basic (potential) moisture balance of grassland (mm) in the Czech Republic on August 18, 2013

CONCLUSIONS

CHMI has been providing drought monitoring on its website since 2006. This is a very useful and helpful service that is intended for a wide range of users, primarily farmers, fruit growers, gardeners. Selected agro-climatic characteristics having a significant impact on agricultural and fruit production are operatively regularly and synoptically presented during the vegetation period for the entire territory of the Czech Republic. In addition to a very brief description of drought monitoring, this paper also pointed out a distinctive weather variability with the example of 2013. In 2013, we expect further innovation and expansion of the entire information system.

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